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Glossary of Terms Relating to River Valley Projects

Part 11 Hydrology

Section 6 Groundwater

(*Second Revision*)

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Groundwater and Related Investigations Sectional Committee, had been approved by the Water Resources Division Council.

This standard was first published in 1985. It was subsequently revised in 1994 wherein certain definitions were modified and definitions relating to field practice were included. This revision has been taken up to bring in further modifications/improvements in the light of experience gained while using the earlier version of the standard.

This standard has been prepared by deriving assistance from the groundwater part in ISO 772 : 2011 'Hydrometric determination — Vocabulary and symbols'. IS 1191 : 2016 'Hydrometry — Vocabulary and symbols (*third revision*)' covers vocabulary and symbols in the field of Hydrometry excluding those relating to groundwater.

Further in this standard the following three principles as adopted in ISO 772 were followed, wherever possible:

- a) to standardize suitable terms without perpetuating unsuitable ones.
- b) to discard any term used with differing meanings and to replace that term by one which has an unequivocal meaning.
- c) to exclude terms which are self-evident.

Indian Standard

GLOSSARY OF TERMS RELATING TO RIVER VALLEY PROJECTS

PART 11 HYDROLOGY

Section 6 Groundwater

(Second Revision)

1 SCOPE

This standard (Part 11/Section 6) covers definitions of terms relating to groundwater.

2 GENERAL TERMS

2.1 Absorbed Water — Water and/or dissolved matter incorporated within the structure of solid, soil or mineral particles.

2.2 Abstraction — Removal of water from a borehole or well.

2.3 Access Tube, Dip Tube — Pipe inserted into a well to permit safe installation of instruments, thus safeguarding them from touching or becoming entangled with the pump or other equipment in the well.

2.4 Acoustic Impedance — Product of seismic velocity and density of a layer.

NOTE — The reflection of a seismic wave depends on the contrast in acoustic impedance.

2.5 Adhesive Water — Water forming a film around soil particles, over absorbed water, and held by forces of molecular attraction after gravity water has drained, but having less strength than adsorption water and without perceptible emission of heat.

NOTE — Adsorbed water is entirely fixed, whereas adhesive or pellicular water may move from one particle to another. This water can't be abstracted under normal conditions.

2.6 Adsorbed Water — Water held on the surface of individual soil particles by the forces of molecular attraction, with emission of heat (heat of wetting).

2.7 Air Lifting — Method of producing a discharge of water from a borehole by the injection of compressed air.

2.8 Air Line — Water-level measuring device consisting of an open-ended tube of small diameter, fixed in position, that is accessible from the top of the casing and extends to below the water level in a well where pressurized air measurements can be used to determine the depth of the water.

2.9 Anisotropy — Variation in physical property with direction of measurement.

NOTE — In the electrical resistivity method, micro-, macro- and pseudo-anisotropy are involved.

2.10 Annual Depletion Rate — The average rate over a period of years at which withdrawals in excess of recharge deplete the storage depth III a groundwater reservoir.

2.11 Anomaly (Groundwater) — Any deviation in a physical property from a uniform regional trend, caused by variations in the character of target (due to the presence of a causative body at the subsurface).

2.12 API Unit — Unit or counting rate used for scaling gamma-ray logs and neutron logs.

NOTE — API is the abbreviation for the American Petroleum Institute.

2.13 Apparent Resistivity — Ratio of the measured voltage to the input current, multiplied by the geometric factor of the electrode configuration.

NOTE — It would be true resistivity if the subsurface is homogeneous (scale of homogeneity referred to the dimension of the electrode geometry).

2.14 Apparent Velocity of Groundwater — Apparent distance covered per unit time by groundwater in the saturated zone.

NOTE — It is defined as the product of the coefficient of permeability and hydraulic gradient, divided by the porosity of the porous medium through which the groundwater is moving.

2.15 Aquiclude — Stratum or group of strata which, although porous and capable of absorbing water slowly, will not transmit water rapidly enough to furnish a sufficient supply for a well or spring, even under saturated conditions.

2.16 Aquifer — Stratum, group of strata, or part of a strata containing sufficient saturated permeable material to yield significant quantities of water to wells, boreholes, or springs.

2.17 Aquifer Loss — Head loss at a pumped or overflowing well associated with groundwater flow through the aquifer to the well face.

2.18 Aquifer Properties — Properties of an aquifer that determine its hydraulic behaviour and its response to abstraction.

2.19 Aquifer Test — A test involving the withdrawal of measured quantities of water from or addition of water to, a well and measurement of resulting changes in head of the aquifer both during or after the period of discharge or addition.

2.20 Aquifuge — Impermeable stratum which has no interconnected openings and hence cannot absorb or transmit water.

2.21 Aquitard — Saturated but poorly permeable stratum that impedes groundwater movement and does not yield water to a well, but that may transmit appreciable water to and from adjacent aquifers.

2.22 Area of Artesian Flow — A land or water surface which lies below a piezometric surface. It is an area in which the water of some underlying aquifer is under sufficient pressure to rise above the surface.

2.23 Argillaceous — Containing clay minerals.

2.24 Artesian Basin — Areal extent of a confined aquifer.

2.25 Artesian Flow — Natural flow above the ground from wells and springs in an artesian basin.

2.26 Artesian Head — The height above the bottom of the upper confining formation, to which the water in a confined aquifer would rise, if free to do so.

2.27 Artesian Pressure — The pressure exerted by a body of water confined in a water bearing geologic formation, against a superimposed impermeable or less permeable formation, the pressure usually being due to the fact that the free water level of the sub-surface water body stands at a higher level than that of the bottom of the upper confining formation.

2.28 Artesian Spring — Water emerging under artesian pressure, generally through some fissure or other opening, in the confining bed that overlies an aquifer.

2.29 Artesian Water — Sub-surface water under sufficient pressure to cause it to rise above the bottom of the superimposed confining formation, if afforded an opportunity to do so. Flowing artesian wells are produced when the pressure is sufficient to force the water above the land surface.

2.30 Artificial Recharge — Augmentation of the natural infiltration of precipitation, or surface water, into underground strata by some method of construction, spreading of water, or by artificially changing natural conditions.

2.31 Base Flow — The sustained or dry weather flow of streams resulting from the outflow of permanent or perched groundwater and from the draining of large lakes and swamps.

2.32 Bed Resolution — Minimum bed thickness that can be resolved.

2.33 Blind Zone — Layer having a seismic velocity less than that in the layer overlying it.

2.34 Bonding — Seal between a borehole lining/casing and the geological formation.

2.35 Borehole, Well — Hole, usually vertical, bored to determine ground conditions, extract water or measure groundwater level.

2.36 Bouguer Anomaly — Anomaly obtained after applying latitude, terrain, and elevation (free air and Bouguer) corrections to the observed gravity value and finally subtracting it from the measured value at some particular station in the survey area.

2.37 Bouguer Correction — Correction made to observed gravity data to account for the attraction (gravitational) of the rock between the datum and the plane of measurement.

2.38 Cable Boom — Rigid support from which the geophysical sonde and cable are suspended.

2.39 Calibration Tail — Section of field log carrying information on sonde calibration.

2.40 Capillary Fringe, Capillary Zone — Zone immediately above the water table extending up to the limit of capillary rise of water.

NOTE — It may consist solely of capillary water or it may be combined with gravity water in transit to the water table. All pores are filled, but the water is at a lower pressure than atmospheric pressure.

2.41 Casing — Tubular retaining structure which is installed in a drilled borehole or excavated well to maintain the borehole opening.

NOTE — Plain (unscreened) casing prevents the entry of water and fine material into the well, while open screened (*see 2.204*) casing allows water ingress but should exclude fines.

2.42 Casing String — Set of lengths of casing assembled for lowering into a borehole.

2.43 Cavern Water — Water in large, tubular or cavernous openings.

2.44 Coefficient of Permeability — Specific discharge under a unit hydraulic gradient at a specified temperature.

2.45 Column Pipe — Part of the rising main within the well.

2.46 Composite Log — Several well logs of the same or similar types, suitable for correlation.

2.47 Cone of Depression — Portion of the potentiometric surface that is perceptibly lowered as a result of abstraction of groundwater from a well.

2.48 Confined Aquifer — An aquifer overlain by sufficiently impermeable strata to inhibit free hydraulic

connection with overlying aquifer, except at the recharge area.

NOTE — Groundwater in confined aquifer moves under the pressure caused by the difference in head between recharge area and discharge areas of the confined aquifer and is under sufficient pressure to rise above the bottom of the upper confining bed, if given an opportunity to do so.

2.49 Confining Bed, Confining Layer, Confining Stratum — Impermeable bed/strata adjacent to an aquifer that restricts or reduces the natural flow of groundwater to or from the aquifer.

2.50 Connate Water — Water which has entered a rock formation and has been entrapped in the interstices of the rock material (either sedimentary or extrusive igneous) for a geologically long period of time, and which has therefore been out of contact with the atmosphere for an appreciable part of a geologic period.

2.51 Contact Resistance — Electrical resistance developed between an electrode planted in the ground and the ground material immediately surrounding it.

NOTE — Contact resistance is reduced by putting water at the electrodes.

2.52 Core — Section of geological formation obtained from a borehole by drilling.

2.53 Critical Velocity of Groundwater — The maximum velocity under which laminar flow can occur in porous media.

2.54 Curve Matching (Borehole Geophysics) — Comparison of individual borehole data in graphical form with standard or control data, including pumping test analysis.

2.55 Curve Matching (Surface Geophysics) — Technique of interpretation in which a field (observed) curve (apparent resistivity, chargeability, etc) is graphically matched with the theoretical curve computed for a known layer arrangement comprising various thicknesses and physical properties.

NOTE — A good match indicates that the modelled arrangement may match the field conditions.

2.56 Darcy's Law — Law expressing the proportionality of the specific discharge flowing through a porous medium to the hydraulic gradient under laminar flow conditions.

NOTE — It is expressed as

$$q = Ki$$

$$\text{or } Q = KAi$$

where

Q is the quantity of water flowing through the aquifer;
 K is a constant depending on the porosity and permeability of the aquifer material and on the properties of the water, called hydraulic conductivity;

i is the loss of head per unit length (or hydraulic gradient);
 q is the specific discharge of water in the aquifer material;
 A is the cross-sectional area of aquifer material through which the water flows.

2.57 Dar Zarrouk Parameters — Longitudinal unit conductance and transverse unit resistance of a geoelectrical layer.

2.58 Deconvolution — Process of inverse filtering to nullify the undesired effect of an earlier filter operation.

2.59 Dipole-Electrode Configuration — Configuration in which the spacing between the current electrode pair and that between the potential electrode pair is considerably reduced in comparison to the distance between these two pairs.

2.60 Discharge of Groundwater — The outflows of water from subsurface to surface.

2.61 Dispersion (Groundwater) — Process by which liquid substance introduced into a groundwater system spreads as it moves through the system.

2.62 Diurnal Correction — Correction applied to magnetic data to compensate for daily fluctuations of the geomagnetic field.

2.63 Drawdown — The reduction in static head within the aquifer resulting from abstraction through a well.

2.64 Drift Correction — Quantitative adjustment to account for a uniform change in the reference value with time.

2.65 Drilling Circulation — Movement of drilling fluid, such as air, foam or liquid, used to clear the borehole during drilling.

2.66 Effective Porosity — It is the ratio of interconnected interstitial volume and the total volume of a water bearing formation.

2.67 Effective Velocity, Actual Velocity, True Velocity, Field Velocity of Groundwater — The velocity measured by the volume of groundwater passing per unit time through unit cross sectional area divided by effective porosity of the water transmitting material.

2.68 Effluent Stream, Gaining Stream — A stream or a stretch of a stream which receives water from groundwater in the zone of saturation. The water surface of such a stream stands at a lower level than the water table, or piezometric surface of the groundwater body, from which it receives water.

2.69 Equipotential Line — Line connecting points having the same potentiometric head.

2.70 Field Capacity, Specific Retention — The amount of water held in the soil after the excess

gravitational water has drained away and after the rate of downward movement of water has materially decreased. Essentially the same as 'specific retention', it is a more general term used in studies of groundwater which covers all types of strata. Furthermore, field capacity is usually expressed as percentage of weight whilst specific retention is generally given as percentage by volume.

2.71 Field Coefficient of Permeability — Coefficient of permeability at the prevailing temperature of water.

2.72 Filter Pack — Granular material introduced into a borehole between the aquifer and a screen or perforated lining to prevent or control the movement of particles from the aquifer into the borehole.

2.73 Fishing Tool — Grappling equipment used to locate and recover items from within a borehole.

2.74 Fissure Water, Fault Water — Water, in open fractures, joints, faults in rock formations, which is usually in abundance only near the ground surface.

2.75 Flow Lines — Lines showing the path of flow of groundwater.

2.76 Flownet — Net of intersecting equipotential lines and flow lines.

2.77 Fluctuation of Water Table — The upward and downward movements of the water table due to periods of recharge and discharge of water in the zone of saturation.

2.78 Fluid Column — Part of a borehole filled with fluid.

2.79 Flushed Zone — Zone at a relatively short radial distance from the borehole, immediately behind the mud cake, where all of the pore spaces are filled with borehole fluid.

2.80 Foot Valve — Non-return valve fitted at the bottom of a suction pipe of a pump.

2.81 Formation — Geological unit or series of units.

2.82 Fracture Porosity — This is porosity associated with a fracture system or faulting. This can create secondary porosity in rocks that otherwise would not be reservoirs for hydrocarbons due to their primary porosity being destroyed or of a rock type not normally considered a reservoir.

2.83 Eddy Current (Geophysics) — Current induced in a conductive body by the primary electromagnetic (EM) field.

NOTE — The secondary EM field produced by the eddy current opposes the primary field.

2.84 Electric Tape, Dipper, Dip-meter — Water-level measuring device that uses an electrical signal, sent

through a cable with fixed distance marks, to determine the water-level relative to a fixed reference point.

NOTE — The electrical signal, which is induced when the sensor makes contact with the water surface, activates an indicator (typically a light, buzzer or needle).

2.85 Equivalence (Geophysics) — Function of product or ratio of two parameters (for example bed thickness and resistivity) where variation in the parameters keeping the ratio or product constant can yield almost the same response.

2.86 Filtering (Geophysics) — Process which eliminates some part of the information (typically noise) entering the system.

NOTE — Filtering is mostly done on the basis of frequency. There are high-frequency cut (low-pass) and low-frequency cut (high-pass), band pass and band elimination (cut) filters used in seismic and other data acquisition and processing.

2.87 Free-Correction — Correction applied to gravity data to account for the fact that current flow measurements are made at different elevations.

NOTE — Free-air gravity anomaly is obtained after applying a free-air correction for the latitude and elevation.

2.88 Geoelectrical Layer — Sub-surface layer characterized by uniform electrical resistivity.

2.89 Geohydrology — The study of that branch of hydrology relating to sub-surface or subterranean water in its geological context.

2.90 Geometric Factor — Numerical value dependent upon the arrangement of electrodes which, when multiplied by the measured voltage-to-current ratio, gives the apparent resistivity.

2.91 Geophone — Instrument which detects seismic energy and converts it into electrical voltage.

NOTE — Relative motion between a suspended coil and a magnet, caused by a seismic wave, generates a voltage in the coil whose amplitude is proportional to the velocity of the exciting seismic disturbance.

2.92 Geophysical Log — Continuous record of a physical or chemical property, plotted against depth or time.

2.93 Geyser — A thermal spring from which hot water steam is intermittently thrown vertically to a considerable height.

2.94 Gradient Configuration — Variation of the Schlumberger configuration where the current electrodes are kept at a great distance from one another and central space is scanned by a small potential dipole.

2.95 Graduated Steel Tape — Water-level measuring device consisting of a flat measuring tape with permanently fixed distance marks that can be wound on a reel.

NOTE — It is only used for measuring in shallow water tables.

2.96 Groundwater — Water within the saturated zone.

2.97 Groundwater Balance — Concept according to which all inputs of water in a defined space and time are equal to the sum of all outputs of water, and the changes of water storage, in the same space and time.

2.98 Groundwater Basin — Physiographic or geological unit containing at least one aquifer of significant areal extent capable of furnishing a substantial water supply.

2.99 Groundwater Budgeting — A detailed estimate of the amount of water added to the groundwater reservoir of a given area (recharge) balanced against estimates of amounts of withdrawals from the groundwater reservoir of the area during a specified period.

2.100 Groundwater Cascade — Descent of groundwater on a steep hydraulic gradient to a lower and flatter water table slope.

NOTE — A cascade can occur below a groundwater barrier or dam, and at the contact of less permeable material with more permeable material, downslope.

2.101 Groundwater Dam, Groundwater Barrier, Subsurface Dyke — Natural or artificial body of material of low permeability which impedes the horizontal movement of groundwater.

2.102 Groundwater Decrement or Discharge — Water abstracted from the groundwater reservoir by evaporation, transpiration, spring flow and effluent seepage, pumping wells and outflow of groundwater under the area within consideration.

2.103 Groundwater Divide — Perceived line/area on a water table or potentiometric surface, on either side of which the water table slopes downwards.

2.104 Groundwater Hydrology — Branch of hydrology relating to subsurface or subterranean water.

2.105 Groundwater Increment, Groundwater Accretion — Water added to the groundwater reservoir in any given time interval from all sources, influent seepage from streams, rainfall, irrigation and inflow of groundwater from outside the area under consideration.

2.106 Groundwater Mound — Elevated area on a water table or on a potentiometric surface, resulting from recharge.

2.107 Groundwater Recharge, Recharge of an Aquifer — Replenishment or addition of water to the groundwater storage by natural processes or artificial methods.

2.108 Groundwater Storage — Volume of groundwater available at any instance of time.

2.109 Groundwater Trench — A trench-shaped depression of the water table caused by effluent seepage into a drainage ditch, drainage pipe, or stream or by movement of groundwater to the thalweg underlying a stream and by artificial pumping by battery of wells.

2.110 Groundwater Turbulent Flow — Turbulent flow which occurs in large openings in the zone of saturation under high velocities.

2.111 Grout — Mixture of cement, bentonite or other additive and water.

2.112 Half-Configuration — Configuration in which one of the current electrodes is kept at infinity (large distance) and need not be collinear with the other three electrodes.

NOTE — It can be used for soundings along radial lines.

2.113 Homogeneity (Groundwater) — Characteristic of a formation with uniform physical property or properties.

NOTES

1 It is a function of the scale of measurement in relation to the uniformity in physical property.

2 Inhomogeneity or heterogeneity indicates non uniformity or dissimilarity in physical property with reference to the scale of measurement.

2.114 Hydraulic Conductivity — Volume of water, at the existing kinematic viscosity, that will move in unit time under a unit hydraulic gradient through a unit area measured perpendicularly to the direction of flow.

NOTES

1 See also Darcy's law as given in 2.56.

2 This definition assumes an isotropic medium in which the pores are completely filled with water.

2.115 Hydraulic Gradient — The change in hydraulic head of the aquifer per unit distance in the direction of flow.

2.116 Hydraulic Head — Height of potentiometric surface (for confined aquifer) or water table (for unconfined aquifer) at a particular location above a datum.

2.117 Hydrogeology — A branch of earth science dealing with the sub-surface distribution of rock formations and their ability to receive, store and transmit water.

2.118 Hydrograph (Groundwater) — Groundwater level graph showing the depth to water level in a well with respect to time.

2.119 Hydro Isopleth Map — A map showing fluctuation of water table with respect to time and space.

2.120 Hydraulic Profile of an Aquifer — A vertical section of the piezometric surface or the water table of an aquifer.

2.121 Impermeable Material — Material that does not permit water to move though it at perceptible rates under the hydraulic gradients normally present.

2.122 Incompetent Stratum — Stratum unable to stand without support.

2.123 Induced Recharge of an Aquifer — Discharge of water from a stream into an aquifer induced by lowering of the water table by artificial means.

2.124 Infiltration Rate — The rate at which infiltration takes place expressed in depth of water per unit of time, usually in millimeters per hour.

2.125 Infiltration Rate Curve — Curve showing the actual rate of infiltration with respect to time.

2.126 Infiltrometer — A device to measure rate of infiltration in experimental observations.

2.127 Influent Percolation — Movement of water, in the zone of aeration, from the ground surface toward the water table under the force of gravity.

2.128 Influent Stream, Loosing Stream — A stream or stretch of a stream which contributes water to the zone of saturation. The water surface of such a stream stands at a higher level than the water table, or piezometric surface, of the groundwater body to which it contributes water.

2.129 In-(Geophysics) — Component of a secondary electromagnetic (EM) field with the same phase angle as that of the exciting primary EM field.

NOTE — The in-phase component attains maxima and minima in step with the primary field.

2.130 Intake Area (Recharge Area) of an Aquifer System — The surface area where the water gets absorbed from perception or surface flow, which eventually reaches the zone of saturation of an aquifer.

2.131 Intermediate Vadose Water — Water in the intermediate vadose zone.

2.132 Intermediate Vadose Zone — It is the portion of the zone of aeration which lies between the lower edge of soil water zone and the upper limit of capillarism.

2.133 Invaded Zone — Portion of formation surrounding a borehole into which drilling fluid has partially penetrated.

2.134 Isopiestic Line, Pressure Surface Contour — A line on a map connecting all points of equal elevation, to which water pressure in a water-bearing formation would rise if free to do so; a line connecting all points of equal pressure in a water-bearing formation under pressure; or a line connecting all points of equal altitude on the upper surface of an unconfined aquifer.

2.135 Jig — Calibrating device for logging sondes.

2.136 Kinematic Viscosity, ν — Ratio of the absolute viscosity of a liquid to its specific gravity at the temperature at which the viscosity is measured.

2.137 Laminar Flow — Flow of a fluid in which the viscous forces are predominant and in which, in channel flow, the fluid particles move in approximately definite and relatively smooth paths with no significant transverse mixing.

NOTE — The Reynolds number is smaller than 500 to 2 000 in flow channels and smaller than 1 to 10 in flow through porous media.

2.138 Land Surface Datum, Ground Level — Average altitude of land surface at a monitored well.

2.139 Latitude Correction (Geophysics) — Correction applied to take into account the variation in gravity values from the equator to the pole.

2.140 Leachate — Liquid that has percolated through solid waste.

2.141 Leaky Aquifer — Aquifer overlain and/or underlain by a relatively thin semi-pervious layer, through which flow into or out of the aquifer can take place.

2.142 Lee-Configuration — Variation of the Wenner array where one additional electrode is placed at the centre between the potential electrodes.

NOTE — Potential difference between the central electrode and either of the two other potential electrodes is measured.

2.143 Lining — A tube or wall used to support the sides of a well, and sometimes to prevent the entry of water.

2.144 Lining Tube — Preformed tube used as the lining for a well.

NOTE — See also casing as given in 2.41 and screen as given in 2.204.

2.145 Lithology — Physical character and mineralogical composition that gives rise to the appearance and properties of a rock or sediment.

2.146 Lithosphere — The solid part of the earth as distinguished from the hydrosphere and the atmosphere. This part of the earth is predominantly composed of rocks (either coherent or incoherent, and including the disintegrated rock materials known as soil and subsoil), together with everything in this rocky crust.

2.147 Logging — Recording of data.

2.148 Longitudinal Conductance — Ratio of the thickness of a geoelectric layer to its resistivity.

2.149 Magnetic Permeability — Ratio of magnetic induction (flux density) in a body to the strength of the inducing magnetic field.

2.150 Magnetic Susceptibility — Ratio of the intensity of magnetization produced in a body to the strength of the magnetic field.

2.151 Measuring Point, Dipping Datum (Groundwater) — Permanent reference marked on well casing.

2.152 Migration (Geophysics) — That part of the processing of seismic reflection data required to plot the dipping reflections at their correct position.

2.153 Mud Cake — Residue deposited on the borehole wall during drilling.

2.154 Natural Recharge — It is that portion of water which gravitates to the zone of saturation under natural conditions.

2.155 Observation Well — Well used for observing groundwater level and/or quality.

2.156 Non-Polarizing Electrode (Geophysics) — Electrode which is not affected by the electrochemical potential generated between the electrode and ground material in which it is planted.

2.157 Normal Moveout — Effect of variation of the shot-geophone distance on the time of arrival of seismic reflection.

2.158 Off-Wenner Configuration — Modification in Wenner configuration to remove or minimize the effect of lateral in-homogeneities.

2.159 Open Borehole — Unlined borehole.

2.160 Overburden — Part of the host medium which lies above the target and is usually of no interest in exploration, but has physical properties that affect the measurements.

2.161 Overflowing (Artesian or Flowing) Well — Well from which groundwater is discharged at the ground surface without the aid of pumping.

2.162 Packer — Device placed in a borehole to seal or plug it at a specific point.

2.163 Perched Groundwater — Groundwater occurring in a limited area in an unsaturated zone separated from the main body of the groundwater by an impervious stratum.

2.164 Perched Spring — A spring whose source of water supply is a perched water body.

2.165 Perennial Spring — A spring that discharges continuously at all seasons of the year.

2.166 Permeability — Characteristic of a material that determines the rate at which fluid pass through it under the influence of differential pressure.

NOTE — In the case of water, referred to as hydraulic conductivity (*see* 2.114).

2.167 Permeable Material — Material that permits water to move through it at perceptible rates under the hydraulic gradients normally present.

2.168 Pellicular Water — *see* 2.5.

2.169 Phasor Diagram — Graph obtained by plotting in-phase and quadrature components of secondary electromagnetic (EM) field for different frequencies of the primary EM field.

2.170 Phreatic Cycle, Cycle of Fluctuation — The total time occupied by a period of rise and a succeeding period of decline of a water table. The most common kinds of cycles are daily, seasonal, annual, and secular.

2.171 Phreatic Surface — Upper boundary of an unconfined groundwater body, at which the water pressure is equal to the atmospheric pressure.

2.172 Phreatic Water — Groundwater occurring in the zone of saturation of unconfined aquifer.

2.173 Physical Yield Limit, Potential Yield — The greatest rate of artificial withdrawal from an aquifer, which can be maintained throughout the foreseeable future without regard to cost of recovery. The physical yield limit is, therefore, equal to the present recharge, or that anticipated in the foreseeable future, less the unrecoverable natural discharge.

2.174 Piestic Interval — The difference in static level between two isopiestic lines or lines of equal pressure.

2.175 Piezometric Surface, Pressure Surface — It is an imaginary surface to which the water in a confined aquifer would rise if afforded an opportunity to do so.

2.176 Piping — Internal erosion of a foundation or embankment caused by seepage.

2.177 Plummet — Plumb bob used for determining the apparent depth of a borehole.

2.178 Plus-method, Hagedoorn Method — Interpretation of seismic refraction data using reversed refraction profiles with shots at opposite ends and the addition and subtraction of travel times for various locations between the shots to indicate refractor depth and velocity.

2.179 Polar Diagram (Geophysics) — Method of plotting resistivity sounding data.

NOTE — The apparent resistivity values of the radial soundings conducted at a point are plotted for various current electrode separations. Results can be used to infer fracture orientations.

2.180 Pore Pressure — Pressure of water in the interstices or voids between the grains of a rock or soil mass.

2.181 Pore Water — Water in the interstices or voids of the formation.

2.182 Porosity — Ratio of the volume of pore space in a sample to the bulk volume of that sample.

2.183 Potential Yield — The maximum rate of artificial withdrawal from an aquifer, which can be maintained throughout the foreseeable future without regard to cost of recovery. The potential yield is, therefore, equal to the present recharge, or that anticipated in the foreseeable future, less the unrecoverable natural discharge.

2.184 Potentiometric Surface — Surface that represents the static head of groundwater.

2.185 Primary Porosity — The porosity developed at the time of formation of geological strata.

2.186 Profile of Water Table — The line formed by the intersection of the water table with a vertical plane. The term is also applied to a graphical representation of such a line.

2.187 Proton Precession Magnetometer — Nuclear precession magnetometer instrument for measuring the magnetic field normal to the earth's magnetic field.

2.188 Pumping Test — A test which is conducted to determine aquifer or well characteristics.

2.189 Quadrature — Out-of-phase or imaginary component of secondary electromagnetic field.

2.190 Radius of Influence — Radius of the cone of depression.

2.191 Reflector — Interface which separates two layers of contrasting acoustic impedance giving rise to reflection.

2.192 Refractor — Layer along which the refracted or head wave travels at a velocity that is higher than that in the overlying layer.

2.193 Remnant Magnetization — *In-situ* residual magnetization remaining in rock after removal of the inducing field.

2.194 Rest Water Level — Water level in the pumped well observed under equilibrium when the pump is off.

2.195 Recuperation — Recovery of water table after cessation of pumping or withdrawal of water.

2.196 Rising Main — Pipe carrying water from within a well to a point of discharge.

2.197 Rock — Natural mass of one or more minerals that may be consolidated or loose (excluding top soil).

2.198 Rugosity — Degree of roughness of the borehole wall.

2.199 Running Plot — A graph of a variable against elapsed time continually updated as measurements are taken.

2.200 Safe Yield — The maximum rate at which water can be artificially withdrawn from an aquifer throughout the foreseeable future without impairing the aquifer.

2.201 Saline Interface — Boundary between waters of different salt content.

2.202 Saturated Zone — The part of an aquifer in which interstices of geological formations are filled with water at a pressure above atmospheric pressure.

NOTE — The lower limit of pressure is the water table.

2.203 Schlumberger Configuration — Collinear four-electrode configuration of current and potential electrodes in which potential electrodes are kept close to the centre of the configuration.

2.204 Screen — Type of lining tube, with apertures designed to permit the flow of water into a well or borehole while preventing the entry of aquifer or filter pack material.

2.205 Secondary Porosity — Porosity developed subsequent to the formation of geological strata.

NOTE — Secondary porosity is produced due to weathering and/or tectonism.

2.206 Seepage — Slow movement of water through pores and interstices of rock and unsaturated soil material into a surface of water such as a river, canal, reservoir, open ground surface or subsurface.

2.207 Sidewalling — Running a log up or down a borehole with the sonde in contact with the borehole wall.

2.208 Skin Depth — Depth of penetration of the electromagnetic (EM) field in a medium, where the intensity of the EM reduces to about 37 percent of its original value at the surface of the earth.

2.209 Slurry — Mixture of fluid and rock fragments formed when drilling or developing a borehole.

NOTE — Slurry can be used as an admixture when drilling.

2.210 Snell's Law — Law applied when a seismic wave encounters a boundary between two media having different velocities.

2.211 Soil Water — The suspended water in the uppermost layer of soil of the zone of aeration and lying near enough to the surface to be discharged into the atmosphere by the transpiration of plants or by evaporation from the soil (includes hygroscopic, capillary and non-capillary water).

2.212 Soil Water Zone — Part of the zone of aeration that consists of soil and other materials near the ground surface, capable of discharging water into the atmosphere by transpiration of plants or by evaporation. The zone extends from the ground surface to major

root zone and the thickness varies with the soil type and vegetation cover.

2.213 Sonde — Cable-suspended probe or tool containing a sensor.

2.214 Spring — Concentrated discharge of groundwater appearing at the ground surface as a current of flowing water.

2.215 Specific Capacity — Rate of discharge of water from the well divided by the drawdown within the well.

2.216 Specific Discharge — The rate of flow of a fluid through a unit cross-section of a porous media.

2.217 Specific Retention — The ratio of the volume of water that a given body of rock or soil will hold against the pull of gravity to the total volume of the body itself.

2.218 Specific Yield — Volume of water released from storage by gravity from a unit area of the aquifer per unit decline of the hydraulic head.

2.219 Stacking — Process of compositing data, for the same parameter, from various data sets for the purpose of eliminating noise.

2.220 Statics — Correction applied to seismic data to nullify the effect of elevation differences encountered along profiles, as well as the effect of a low-velocity weathered layer.

2.221 Static Water Level — The water level in a non-pumping well outside the area of influence of any pumping well. This level registers one point on the water table in a water table well or one point on the pressure surface in a confined water well.

2.222 Static Head — The height, relative to an arbitrary reference, level, or a column of water that can be supported by the static pressure at a given point.

2.223 Steady Flow (Groundwater) — Flow in which parameters, such as velocity, pressure, density and temperature, do not vary sufficiently with time to affect the required accuracy of measurement.

2.224 Storage Coefficient — Volume of water released from storage in a confined aquifer per unit area of the aquifer per unit decline in hydraulic head.

2.225 Sub-Surface Water — Water that occurs beneath the surface of the earth (in the lithosphere), It may be in liquid, solid, or gaseous state. It is also called undergroundwater or subterranean water.

2.226 Subterranean Stream — Body of flowing water that passes through a very large interstice, such as a cave or cavern, or a group of large communicating interstices.

2.227 Suppressed Layer — Layer lacking a response because of its small thickness and/or contrast in physical property with the surrounding environment.

2.228 Suspended Water — Water in the zone of aeration.

2.229 Terrain Correction — Correction applied to measured gravity data to nullify the effect of irregular topographic relief in the immediate vicinity of the station of measurement.

2.230 Transition — Linear or exponential variation of a physical property with depth.

2.231 Transmissivity, T — Rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the saturated aquifer under a unit hydraulic gradient.

2.232 Transverse Resistance — Product of the thickness and resistivity of a geo-electrical layer.

NOTE — Conventionally written as $T = h \times r$ (ohm.m²).

where

T is the transverse resistance;

h is the thickness; and

r is the resistivity.

2.233 Turbulent Groundwater Flow — Fluid flow, which is not laminar or streamline flow and for which the Reynolds number is greater than 10 for flow through porous media.

2.234 Two-(Pole-) Configuration — Configuration in which one current and one potential electrode are kept at infinity (more than 10 times the distance between active electrodes) and perpendicular to the profile along which the other two active electrodes are moved.

2.235 Unconfined Aquifer — Water bearing geological formation with a water table or phreatic surface.

2.236 Unconsolidated Rock — Rock that lacks natural cementation.

2.237 Uniform Flow (Groundwater) — Flow in which the magnitude and direction of flow at a given moment are constant with respect to distance.

2.238 Unsaturated Zone — Soil or rock material between the ground surface and the water table.

2.239 Vadose Water — Water in the unsaturated zone (*see also* 2.228).

2.240 Vibroseis — Seismic survey in which a vibrator is used as a non-destructive source, instead of an explosive, to generate controlled-frequency seismic waves in the ground.

2.241 Viscosity — Property of a fluid whereby it tends, within itself, to resist relative motion.

2.242 Washout — Cavity formed by the action of drilling.

2.243 Water Table — Surface of the saturated zone at which the water pressure is atmospheric.

2.244 Well Development — Physical and chemical treatment of a well to achieve minimum resistance to movement of water between well and aquifer.

2.245 Well Discharge — Volumetric flow rate into or from a well or borehole.

2.246 Well Efficiency — Measure of the performance of a production well.

2.247 Well Loss — Head loss resulting from the flow of groundwater across the well face, including any part of the aquifer affected by drilling and any filter pack or lining tube, into the well and up or down the well to the pump.

2.248 Well Storage — Volume of water released from within the well itself during a reduction in head.

2.249 Wenner Configuration — Collinear four-electrode configuration of potential and current electrodes in which all the electrodes are equidistant.

2.250 Zone of Fluctuation of Water Table, Zone of Phreatic Fluctuation — Zone through which the water table fluctuates from its highest to its lowest level within the formation, in response to the discharge and recharge conditions.

NOTE — Depending upon the position of the water table in the zone, part of the zone will lie in the zone of aeration and the other part will lie in the zone of saturation.

2.251 Zone of Saturation, Saturated Zone — Zone in which interstices of rock or other materials are filled with water at a pressure above atmospheric pressure.

NOTE — The lower limit of pressure is the water table.

2.252 Zone of Weathering — Layer of superficial deposits or bedrock subject to weathering and broadly coinciding with the belt of soil water.

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